Package 'lba'

January 10, 2018

Title Latent Budget Analysis for Compositional Data

Version 2.4.4

Date 2018-01-02

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Depends R (>= 3.1.0), MASS, alabama, plotrix, scatterplot3d, rgl

Description Latent budget analysis is a method for the analysis of a two-way contingency table with an exploratory variable and a response variable. It is specially designed for compositional data.

Encoding latin1

URL https://github.com/ivanalaman/lba

NeedsCompilation no

Repository CRAN

Date/Publication 2018-01-10 18:40:30 UTC

R topics documented:

goodnessfit — *Goodness of Fit results for Latent Budget Analysis*

Description

The goodness of fit results assesses how well the model fits the data. It consists of measures of the resemblance between the observed and the expected data, and the parsimony of the model.

Usage

```
goodnessfit(object,...)

## S3 methods
## Default S3 method:
goodnessfit(object, ...)

## S3 method for class 'lba.ls'
goodnessfit(object, ...)

## S3 method for class 'lba.ls.fe'
goodnessfit(object, ...)

## S3 method for class 'lba.ls.logit'
goodnessfit(object, ...)

## S3 method for class 'lba.mle'
goodnessfit(object, ...)

## S3 method for class 'lba.mle.fe'
goodnessfit(object, ...)

## S3 method for class 'lba.mle.logit'
goodnessfit(object, ...)
```

Arguments

`object`	An object of one of following classes: `lba.ls`, `lba.ls.fe`, `lba.ls.logit`, `lba.mle`, `lba.mle.fe`, `lba.mle.logit`
`...`	Further arguments (required by generic).

Value

The `goodnessfit` function of the method `lba.mle`, `lba.mle.fe` and `lba.mle.logit` returns a list with the slots:

`dfdb`	Degrees of freedom of the base model
`dfd`	Degrees of freedom of the full model
`G2b`	Likelihood ratio statistic of the base model
`G2`	Likelihood ratio statistic of the full model
`chi2b`	Chi-square statistic of the base model
`chi2`	Chi-square statistic of the full model
`proG1`	P-value of likelihood ratio statistic of the base model
`proG`	P-value of likelihood ratio statistic of the full model
`prochi1`	P-value of chi-square statistic of the base model
`prochi`	P-value of chi-square statistic of the full model
`AICb`	AIC criteria of the base model
`AICC`	AIC criteria of the full model
`BICb`	BIC criteria of the base model
`BICC`	BIC criteria of the full model
`CAICb`	CAIC criteria of the base model
`CAIC`	CAIC criteria of the full model
`delta1`	Normed fit index
`delta2`	Normed fit index modified
`rho1`	Bollen index
`rho2`	Tucker-Lewis index
`RSS1`	Residual sum of square of the base model
`RSS`	Residual sum of square of the full model
`impRSS`	Improvement of RSS
`impPB`	Improvement per budget
`impDF`	Average improvement per degree of freedom
`D1`	Index of dissimilarity of the base model
`D`	Index of dissimilarity of the full model
`pccb`	Proportion of correctly classified data of the base model
`pcc`	Proportion of correctly classified data of the full model
`impD`	Improvement of proportion of correctly classified data
`impPCCB`	Improvement of Proportion of correctly classified data per budget
`AimpPCCDF`	Average improvement of Proportion of correctly classified data per degree of freedom
`mad1`	Mean angular deviation of the base model

madk	Mean angular deviation of the full model
impMad	Improvement mean angular deviation
impPBsat	Improvement mean angular deviation per budget
impDFsat	Average improvement mean angular deviation per degree of freedom

The goodnessfit function of the method lba.ls, lba.ls.fe and lba.ls.logit returns a list with the slots:

dfdb	Degrees of freedom of the base model
dfd	Degrees of freedom of the full model
RSS1	Residual sum of square of the base model
RSS	Residual sum of square of the full model
impRSS	Improvement of RSS
impPB	Improvement per budget
impDF	Average improvement per degree of freedom
D1	Index of dissimilarity of the base model
D	Index of dissimilarity of the full model
pccb	Proportion of correctly classified data of the base model
pcc	Proportion of correctly classified data of the full model
impD	Improvement of proportion of correctly classified data
impPCCB	Improvement of Proportion of correctly classified data per budget
AimpPCCDF	Average improvement of Proportion of correctly classified data per degree of freedom
mad1	Mean angular deviation of the base model
madk	Mean angular deviation of the full model
impMad	Improvement mean angular deviation
impPBsat	Improvement mean angular deviation per budget
impDFsat	Average improvement mean angular deviation per degree of freedom

Note

For a detailed and complete discussion about goodness of fit results for latent budget analysis, see van der Ark 1999.

References

Agresti, Alan. 2002. *Categorical Data Analysis, second edition*. Hoboken: John Wiley \& Sons.

van der Ark, A. L. 1999. *Contributions to Latent Budget Analysis, a tool for the analysis of compositional data*. Ph.D. Thesis University of Utrecht.

See Also

summary.goodnessfit.lba.ls, summary.goodnessfit.lba.mle,lba

Examples

```
data('votB')

# Using LS method (default) without constraint
# K = 2
ex1 <- lba(parties ~ city,
           votB,
           K = 2)

gx1 <- goodnessfit(ex1)
gx1

# Using MLE method without constraint
# K = 2
exm <- lba(parties ~ city,
           votB,
           K = 2,
           method='mle')

gxm <- goodnessfit(exm)
gxm

# Using LS method (default) with LOGIT constrain
data('housing')

# Make cross-table to matrix design.
tbh <- xtabs(value ~ Influence + Housing, housing)

Xis <- model.matrix(~ Housing*Influence,
                    tbh,
                    contrasts=list(Housing='contr.sum',
                                   Influence='contr.sum'))

tby <- xtabs(value ~ Satisfaction + Contact, housing)

Yis <- model.matrix(~ Satisfaction*Contact,
                    tby,
                    contrasts=list(Satisfaction='contr.sum',
                                   Contact='contr.sum'))[,-1]

S <- 12
T <- 5

tabs <- xtabs(value ~ interaction(Housing,
                                  Influence) + interaction(Satisfaction,
                                  Contact),
              housing)
## Not run:
ex2 <- lba(tabs,
           K = 2,
           logitA = Xis,
           logitB = Yis,
```

```
            S = S,
            T = T,
            trace.lba=FALSE)

gex2 <- goodnessfit(ex2)
gex2

## End(Not run)
```

---

housing *The Satisfaction with Housing Conditions Study*

Description

The housing data frame has 72 rows and 5 columns. The observations were obtained from an investigation of Satisfaction with housing conditions carried out by the Danish Building Research Institute and the Danish Institute of Mental Health Research.

Usage

```
housing
```

Format

This data frame contains the following columns:

Housing A factor with levels: Apartment; Atrium; Terraced; Tower.

Influence A factor with levels: hi; low; med.

Contact A factor with levels: high; low.

Satisfaction A factor with levels: hi; low; med.

value The absolute frequencies of which factor.

Source

Madsen, M. (1976) Statistical analysis of multiple contingency tables: Two examples. *Scandinavian Journal of Statistics* **3**, 97–106.

References

van der Ark, A. L. 1999. *Contributions to Latent Budget Analysis, a tool for the analysis of compositional data*. Ph.D. Thesis University of Utrecht.

`Latent Budget Analysis` *Latent Budget Analysis (LBA) for Compositional Data*

Description

Latent budget analysis (LBA) is a method for the analysis of contingency tables, from where the compositional data is derived. It is used to understand the relationship between the table rows and columns, where the rows denote the categories of the explanatory variable and the columns denote the categories of the response variable.

Details

The row vectors of the compositional data are called observed budgets which are approximated by the expected budgets. The LBA allows us to find which categories of the response are related to different groups of the explanatory categories. If the table has a product multinomial distribution we can understand the latent budget model (LBM) as explaining the relationship between the explanatory and the response variables assuming that conditioned on the latent variable they are independent. In that sense, the latent budgets, which are categories of a latent variable, are hidden values which explain the relationship between the explanatory and response variables. LBA reduce the dimensionality of the original problem, thus making it easier to understand its hidden relations.

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We are grateful to José C. Faria, Andreas L. van der Ark and Fábio M. Correa for suggestions.

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`lba` *Latent Budget Analysis (LBA) for Compositional Data*

Description

Latent budget analysis (LBA) is a method for the analysis of contingency tables, from where the compositional data is derived. It is used to understand the relationship between the table rows and columns, where the rows denote the categories of the explanatory variable and the columns denote the categories of the response variable.

Usage

```
lba(obj, ...)

## S3 method for class 'matrix'
lba(obj,
    A           = NULL,
```

```
    B           = NULL,
    K           = 1L,
    cA          = NULL,
    cB          = NULL,
    logitA      = NULL,
    logitB      = NULL,
    omsk        = NULL,
    psitk       = NULL,
    S           = NULL,
    T           = NULL,
    row.weights = NULL,
    col.weights = NULL,
    tolG        = 1e-10,
    tolA        = 1e-05,
    tolB        = 1e-05,
    itmax.unide = 1e3,
    itmax.ide   = 1e3,
    trace.lba   = TRUE,
    toltype     = "all",
    method      = c("ls", "mle"),
    what        = c("inner","outer"), ...)

## S3 method for class 'table'
lba(obj,
    A           = NULL,
    B           = NULL,
    K           = 1L,
    cA          = NULL,
    cB          = NULL,
    logitA      = NULL,
    logitB      = NULL,
    omsk        = NULL,
    psitk       = NULL,
    S           = NULL,
    T           = NULL,
    row.weights = NULL,
    col.weights = NULL,
    tolG        = 1e-10,
    tolA        = 1e-05,
    tolB        = 1e-05,
    itmax.unide = 1e3,
    itmax.ide   = 1e3,
    trace.lba   = TRUE,
    toltype     = "all",
    method      = c("ls", "mle"),
    what        = c("inner","outer"), ...)

## S3 method for class 'formula'
```

```
lba(formula, data,
    A           = NULL,
    B           = NULL,
    K           = 1L,
    cA          = NULL,
    cB          = NULL,
    logitA      = NULL,
    logitB      = NULL,
    omsk        = NULL,
    psitk       = NULL,
    S           = NULL,
    T           = NULL,
    row.weights = NULL,
    col.weights = NULL,
    tolG        = 1e-10,
    tolA        = 1e-05,
    tolB        = 1e-05,
    itmax.unide = 1e3,
    itmax.ide   = 1e3,
    trace.lba   = TRUE,
    toltype     = "all",
    method      = c("ls", "mle"),
    what        = c("inner","outer"), ...)

## S3 method for class 'ls'
lba(obj,
    A           ,
    B           ,
    K           ,
    row.weights ,
    col.weights ,
    tolA        ,
    tolB        ,
    itmax.unide ,
    itmax.ide   ,
    trace.lba   ,
    what        , ...)

## S3 method for class 'mle'
lba(obj,
    A           ,
    B           ,
    K           ,
    tolG        ,
    tolA        ,
    tolB        ,
    itmax.unide ,
    itmax.ide   ,
```

```
    trace.lba   ,
    toltype     ,
    what        , ...)

## S3 method for class 'ls.fe'
lba(obj,
    A           ,
    B           ,
    K           ,
    cA          ,
    cB          ,
    row.weights ,
    col.weights ,
    itmax.ide   ,
    trace.lba   , ...)

## S3 method for class 'mle.fe'
lba(obj,
    A          ,
    B          ,
    K          ,
    cA         ,
    cB         ,
    tolG       ,
    tolA       ,
    tolB       ,
    itmax.ide  ,
    trace.lba  ,
    toltype    , ...)

## S3 method for class 'ls.logit'
lba(obj,
    A           ,
    B           ,
    K           ,
    cA          ,
    cB          ,
    logitA      ,
    logitB      ,
    omsk        ,
    psitk       ,
    S           ,
    T           ,
    row.weights ,
    col.weights ,
    itmax.ide   ,
    trace.lba   , ...)
```

```
## S3 method for class 'mle.logit'
lba(obj,
    A          ,
    B          ,
    K          ,
    cA         ,
    cB         ,
    logitA     ,
    logitB     ,
    omsk       ,
    psitk      ,
    S          ,
    T          ,
    itmax.ide  ,
    trace.lba  , ...)
```

Arguments

`obj,formula`	The function is generic, accepting some forms of the principal argument for specifying a two-way frequency table. Currently accepted forms are matrix, data frame (coerced to frequency tables), objects of class `"xtabs"` or `"table"` and one-sided formulae of the form `Col1 + Col2 + ... + Coln ~ Row1 + Row2 + ... + Rown`, where `Rown` and `Coln` are nth row (the mixing parameters) and column variable (the latent components).
`data`	A data frame containing variables in `formula`.
`A`	The starting value of a (I x K) matrix containing the mixing parameters, if given. The default is `NULL`, producing random starting values.
`B`	The starting value of a (J x K) matrix containing the latent components, if given. The default is `NULL`, producing random starting values.
`K`	Integer giving the number of latent budgets chosen by the user. The default is `1`.
`cA`	The value of a (I x K) matrix containing the constraints on the mixing parameters. Fixed constraints are the values themselves which are numbers in the [0,1] interval. The optional equality constraints are indicated by an integer starting from 2, such that parameters that must be equal have the same integer. The default is `NULL`, indicating no constraints.
`cB`	The value of a (J x K) matrix containing the constraints on the latent components. Fixed constraints are the values themselves which are numbers in the [0,1] interval. The optional equality constraints are indicated by an integer starting from 2, such that parameters that must be equal have the same integer. The default is `NULL`, indicating no constraints.
`logitA`	Design (IxS) matrix for row-covariates. The first column contains 1Â´s, indicating a constant covariate. The entries may be continuous or dummy coded values.
`logitB`	Design (JxT) matrix for column-covariates. The entries may be continuous or dummy coded values.
`omsk`	A (SxK) matrix giving the starting values for the multinomial logit parameters of the row covariates. The default is `NULL`, producing random starting values.

psitk — A (TxK) matrix giving the starting values for the multinomial logit parameters of the column covariates. The default is `NULL`, producing random starting values.

S — Number of row-covariates. The default is `NULL`.

T — Number of column-covariates. The default is `NULL`.

row.weights — A vector with the same number of rows of the matrix of the weighted least squares method. If is `NULL` (default), the weights are

$$\sqrt{n_{i+}/n_{++}}$$

.

col.weights — A vector with the same number of columns of the matrix of the weighted least squares method. If is `NULL` (default), the weights are

$$1/\sqrt{n_{+j}/n_{++}}$$

.

tolG — A tolerance value for judging when convergence has been reached. It is based on the estimated likelihood ratio statistics G2. The default is `1e-10`.

tolA — A tolerance value for judging when convergence has been reached. When the one-iteration change in the maximum of the absolute value of the element wise difference of the estimated matrices A is less than tolA. The default is `1e-05`.

tolB — A tolerance value for judging when convergence has been reached. When the one-iteration change in the maximum of the absolute value of the element wise difference of the estimated matrices B is less than tolB. The default is `1e-05`.

itmax.unide — Maximum number of iterations performed by the mle or ls method, if convergence is not achieved, before identification parameters. The default is `1e3`.

itmax.ide — Maximum number of iterations performed by the mle or ls method in the identification process. Is used too when the constrained fixed, equality and logit are required. The default is `1e3`.

trace.lba — Logical, indicating whether the `base` function `optim` and `constrOptim.nl` from package **alabama**, will trace their results. The default is `TRUE`.

toltype — String indicating which kind of tolerance to be used. That is, the EM algorithm stops updating and considers the maximum log-likelihood to have been found. Their types are: `"all"` when the one-iteration change in the estimated likelihood ratio statistics G2 is less than tolG, and the one-iteration change in the maximum of the absolute value of the element wise difference of the estimated matrices A is less than tolA and the same for estimated matrices B with respect to tolB; `"G2"` when the only one-iteration change in the estimated likelihood ratio statistics G2 is less than tolG; `"ab"` when only the one-iteration change in the maximum of the absolute value of the element wise difference of the estimated matrices A is less than tolA and the same for estimated matrices B with respect to tolB. `toltype` works only for method = `"mle"`. The default is `"all"`. The ls method uses only `"ab"` as tolerance limit.

method — String indicating which kind of estimating method. They are: `"ls"` when least squares, either weighted or ordinary, method is used; `"mle"` when maximum likelihood method is used. The default is `"ls"`.

`what`	String indicating which kind identified solutions for mixing parameters and latent budgets matrices. They are: the `"inner"` extreme solution and the `"outer"` extreme solution. The default is `"inner"`.
`...`	Further arguments (required by generic).

Value

The method `lba.ls` and `lba.mle` returns a list of class `lba.ls` and `lba.mle` respectively with the slots:

`P`	The compositional data matrix which is formed by dividing the raw data matrix by their corresponding total, its rows are called observed budgets.
`pij`	Matrix whose rows are the expected budgets.
`residual`	Residual matrix `P - pij`.
`A`	(I x K) matrix of the unidentified the mixing parameters.
`B`	(J x K) matrix of the unidentified the latent components.
`Aoi`	(I x K) matrix of the identified mixing parameters, they may be either the inner extreme values or the outer extreme values.
`Boi`	(J x K) matrix of the identified latent componentes, they may be either the inner extreme values or the outer extreme values.
`rescB`	(J x K) matrix of the rescaled latent components.
`pk`	Budget proportions.
`val_func`	Value of least squared or likelihood function achieved.
`iter_unide`	Number of unidentified iterations.
`iter_ide`	Number of identified iterations.

The method `lba.ls.fe` and `lba.mle.fe` returns a list of class `lba.ls.fe` and `lba.mle.fe` respectively with the slots:

`P`	The compositional data matrix which is formed by dividing the raw data matrix by their corresponding row total, its rows are called observed budgets.
`pij`	Matrix whose rows are the expected budgets.
`residual`	Residual matrix `P - pij`.
`A`	(I x K) matrix of the unidentified the mixing parameters.
`B`	(J x K) matrix of the unidentified the latent components.
`rescB`	(J x K) matrix of the rescaled latent components.
`pk`	Budget proportions.
`val_func`	Value of least squared or likelihood function achieved.
`iter_ide`	Number of identified iteractions.

The method `lba.ls.logit` and `lba.mle.logit` returns a list of class `lba.ls.logit` and `lba.mle.logit` respectively with the slots:

P	The compositional data matrix which is formed by dividing the raw data matrix by their corresponding total, its rows are called observed budgets.
pij	Matrix whose rows are the expected budgets.
residual	Residual matrix P - pij.
A	(I x K) matrix of the unidentified the mixing parameters.
B	(J x K) matrix of the unidentified the latent componentes.
rescB	(J x K) matrix of the rescaled latent components.
pk	Budget proportions.
val_func	Value of least squared or likelihood function achieved.
iter_ide	Number of identified iterations.
omsk	A (SxK) matrix giving estimated values of the multinomial logit parameters of the row covariates.
psitk	A (TxK) matrix giving the estimated values for the multinomial logit parameters of the column covariates.

Note

The user has two options to entry the data: the raw data and the tabulated data. If the raw data is imported, he may indicate which, among the variables, comprises the row and which the column variable and let the `lba.formula` function make the tabulation. The user may also tabulate the data with the available functions in R. Recalling that if this second option is used, the object must be of the class `xtabs`, `table` or `matrix`. If the user imports the tabulated data, the class is, in general, `data.frame` and so, it is necessary to transform the object data into a `matrix`.

The function `lba` uses EM algorithm to maximise the latent budget model log-likelihood function; the Active Constraints Methods (ACM) to minimise either the weighted least squares (wls), or ordinary least squares (ols) functions; and "BFGS" variable metric method in `constrOptim.nl` function of **alabama** package and in `optim` function of **stats** package used in identification for K >= 3, in constraint algorithm for ls method, in multinomial logit constraints and in some parts of constraining for mle method. Depending on the starting parameters, those algorithms may only locate a local, rather than global, maximum. This becomes more and more of a problem as K, the number of latent budgets, increases. It is therefore highly advisable to run `lba` multiple times until you are relatively certain that you have located the global maximum log-likelihood or the global minimum least squares.

References

Agresti, Alan. 2002. *Categorical Data Analysis, second edition*. Hoboken: John Wiley \& Sons.

de Leeuw, J., and van der Heijden, P.G.M. 1988. "The analysis of time-budgets with a latent time-budget model". In E. Diday (Ed.), *Data Analysis and Informatics V*. pp. 159-166. Amsterdam: North-Holland.

de Leeuw, J., van der Heijden, P.G.M., and Verboon, P. 1990. "A latent time budget model". *Statistica Neerlandica*. 44, 1, 1-21.

Dempster, A.P., Laird, N.M., and Rubin, D.B. 1977. "Maximum likelihood from incomplete data via the EM algorithm". *Journal of the Royal Statistical Society, Series*. 39, 1-38.

van der Ark, A.L. 1999. *Contributions to Latent Budget Analysis, a tool for the analysis of comositional data*. Ph.D. Thesis University of Utrecht.

van der Heijden, P.G.M., Mooijaart, A., and de Leeuw, J. 1992. "Constrained latent budget analysis". In P.V. Marsden (Ed.), *Sociological Methodology* pp. 279-320. Cambridge: Blackwell Publishers.

See Also

goodnessfit, summary.lba.ls,summary.lba.mle,plotlba,plotcorr

Examples

```
data('votB')

# Using LS method (default) without constraint
# K = 2
ex1 <- lba(parties ~ city,
           votB,
           K = 2)
ex1

# Already tabulated data? Ok!
data('PerfMark')

## Not run:
ex2 <- lba(as.matrix(PerfMark),
           K = 2,
           what='outer')
ex2

## End(Not run)
# Using LS method (default) with constraint
# Fixed constraint to mixing parameters
cakiF1 <- matrix(c(0.2, NA, NA,
                   NA , NA,0.2,
                   NA , NA,0.2,
                   0.3, NA, NA,
                   0.2, NA, NA,
                   NA , NA, NA),
                 byrow = TRUE,
                 ncol  = 3)

# K = 3
## Not run:
exf1 <- lba(parties ~ city,
            votB,
            cA = cakiF1,
            K = 3)
exf1

## End(Not run)
# Using LS method (default) with LOGIT constrain
```

```
data('housing')

# Make cross-table to matrix design.
tbh <- xtabs(value ~ Influence + Housing, housing)

Xis <- model.matrix(~ Housing*Influence,
                    tbh,
                    contrasts=list(Housing='contr.sum',
                                   Influence='contr.sum'))

tby <- xtabs(value ~ Satisfaction + Contact, housing)

Yis <- model.matrix(~ Satisfaction*Contact,
                    tby,
                    contrasts=list(Satisfaction='contr.sum',
                                   Contact='contr.sum'))[,-1]

S <- 12
T <- 5

tabs <- xtabs(value ~ interaction(Housing,
                                  Influence) + interaction(Satisfaction,
                                  Contact),
              housing)
## Not run:
exlogit2 <- lba(tabs,
           K = 2,
           logitA = Xis,
           logitB = Yis,
           S = S,
           T = T,
           trace.lba=FALSE)
exlogit2

## End(Not run)
```

MANHATAN *The Midtown Manhattan Study*

Description

The MANHATAN data frame has 25 rows and 3 columns. The observations were obtained in a study carried out by the sociologist Leo Srole and describe the cross-classification of 1660 adults in Manhattan, ages 20-59, obtained from a sample of midtown residents.

Usage

```
MANHATAN
```

Format

This data frame contains the following columns:

health A factor with levels: `Well`; `Misy`; `Mosy`; `Imp`.

sococon A factor with levels: `A`; `B`; `C`; `D`; `E`; `F`.

value The absolute frequencies of which factor.

Source

Goodman, L. A. (1987) New Methods for Analysing the Intrinsic Character of Qualitative Variables Using Cross-Classified Data. *American Journal of Sociology* **93**, 529–583.

References

van der Ark, A. L. 1999. *Contributions to Latent Budget Analysis, a tool for the analysis of compositional data*. Ph.D. Thesis University of Utrecht.

PerfMark — *BEAUTY SALON MANAGEMENT*

Description

The `PerfMark` data frame has 31 rows and 46 columns. The data set is the result of a survey of 47 beauty salons located at the city of Lavras, Brazil, consisting of two types of questions; the first identifies the profile of the owner manager (explanatory variable), the second are questions referring to the degree of professionalism with respect to planing, market and finances (response variable). The data set is already cross-tabulated.

Usage

```
PerfMark
```

Format

This data frame contains the following columns referring the absolute frequencies to each row variable:

Planning variables:

PA14 What is the dependence of the owner to function properly?.

PA20 What are your plans towards next year? only a dream.

PA21 What are your plans towards next year? vague goals. Marketing variables:

MA11 Your business tries to systematically assess the customer satisfaction and use that as a basis for management decisions. Alternative 1.

MA12 Your business tries to systematically assess the customer satisfaction and use that as a basis for management decisions. Alternative 2.

MA20 Your business offers more than the usual services. Alternative 0.

MA21 Your business offers more than the usual services. Alternative 1.

MA30 Your business is focused to further customer loyalty. Alternative 0.

MA31 Your business is focused to further customer loyalty. Alternative 1.

MA32 Your business is focused to further customer loyalty. Alternative 2.

MA42 What is the proportion, among current customers, of those who are customers for more than 6 months. Alternative 2.

MA43 What is the proportion, among current customers, of those who are customers for more than 6 months. Alternative 3.

MB12 Your business offers more services than when it began. Alternative 2.

MB22 How is your business quality perceived as compared to the competition? Alternative 2.

MB23 How is your business quality perceived as compared to the competition? Alternative 3.

MB31 How is your business range of services perceived as compared to the competition? Alternative 1.

MB32 How is your business range of services perceived as compared to the competition? Alternative 2.

MC11 What is your business level of prices perceived as compared to the competition? Alternative 1.

MC12 What is your business level of prices perceived as compared to the competition? Alternative 2.

MD13 Your business location is perceived as appropriate to the target market. Alternative 3.

ME10 Your business uses formal media to advertise itself. Alternative 0.

ME11 Your business uses formal media to advertise itself. Alternative 1.

ME25 Your business uses formal media to advertise itself. Alternative 5. Financial variables:

F10 Your business clearly separates the owner bills from the business bills. Alternative 0.

F14 Your business clearly separates the owner bills from the business bills. Alternative 4.

F20 Your owners withdrawal are planned and controlled in advance. Alternative 0.

F21 Your owners withdrawal are planned and controlled in advance. Alternative 1.

F24 Your owners withdrawal are planned and controlled in advance. Alternative 4.

F31 Your business pays for its purchases in installments. Alternative 1.

F34 Your business pays for its purchases in installments. Alternative 4.

F42 Your business knows today whether it will be able to pay its short-term bills of 60 days. Alternative 2.

F44 Your business knows today whether it will be able to pay its short-term bills of 60 days. Alternative 4.

F50 Your business uses short-term cash-flow analysis to plan for its short-term bills. Alternative 0.

F51 Your business uses short-term cash-flow analysis to plan for its short-term bills. Alternative 1.

F63 Your business has formal control of the monthly amount it makes from its services. Alternative 3.

F64 Your business has formal control of the monthly amount it makes from its services. Alternative 4.

F70 Your business uses either credit card, checkbook payment or loans, to finance its needs for working capital. Alternative 0.

F74 Your business uses either credit card, checkbook payment or loans, to finance its needs for working capital. Alternative 4.

F80 Your business uses specific credit to finance its needs for capital. Alternative 0.

F91 The company demonstrates knowledge to properly assess the costs of products used in services and costs of renting and taxes. Alternative 1.

F93 The company demonstrates knowledge to properly assess the costs of products used in services and costs of renting and taxes. Alternative 3.

F100 Your business clearly identifies the need for working capital. Alternative 0.

F111 Your business lays down the price of services in a systematic way. Alternative 1.

F113 Your business lays down the price of services in a systematic way. Alternative 3.

F120 The company calculates the interest on contracted loans. Alternative 0.

F125 The company calculates the interest on contracted loans. Alternative 5.

Source

Jelihovschi, E.G., Alves, R.R., and Correa, F.M. 2011. *Interacting latent budget analysis and correspondence analysis to analyze beauty salon management data*. Biometric Brazilian Journal, 29, 657-673.

References

van der Ark, A. L. 1999. *Contributions to Latent Budget Analysis, a tool for the analysis of compositional data*. Ph.D. Thesis University of Utrecht.

`plotcorr` *Plot lba objects using the correspondence analysis approach as suggested by Jelihovschi (2011).*

Description

S3 methods for `lba` objects.

Usage

```
plotcorr(x, ...)

## S3 method for class 'lba.1d'
plotcorr(x,
         xlim           = NULL,
         ylim           = NULL,
```

```
         xlab           = NULL,
         ylab           = NULL,
         metrics        = TRUE,
         radius         = rep(0.5,2),
         col.points     = NULL,
         height.points  = NULL,
         labels.points  = NULL,
         pch.points     = NULL,
         pos.points     = NULL,
         args.legend    = NULL,
         height.budget  = NULL,
         labels.budget  = NULL,
         pch.budget     = NULL,
         pos.budget     = NULL,
         cex.budget     = NULL,
         col.budget     = NULL,
         with.ml        = c("mix","lat"),
         ...)

## S3 method for class 'lba.2d'
plotcorr(x,
         dim            = c(1,2), #only K = 3
         xlim           = NULL,
         ylim           = NULL,
         xlab           = NULL,
         ylab           = NULL,
         args.legend    = NULL,
         col.points     = NULL,
         labels.points  = NULL,
         pch.points     = NULL,
         pos.points     = NULL,
         labels.budget  = NULL,
         pch.budget     = NULL,
         pos.budget     = NULL,
         cex.budget     = NULL,
         col.budget     = NULL,
         with.ml        = c("mix","lat"),
         ...)

## S3 method for class 'lba.3d'
plotcorr(x,
         rgl.use        = FALSE,
         dim            = c(1,2,3), #only K >= 3
         xlim           = NULL,
         ylim           = NULL,
         zlim           = NULL,
         xlab           = NULL,
         ylab           = NULL,
```

```
zlab           = NULL,
args.legend    = NULL, #only rgl.use=FALSE
col.points     = NULL,
labels.points  = NULL,
pch.points     = NULL,
pos.points     = NULL,
labels.budget  = NULL,
pch.budget     = NULL,
pos.budget     = NULL,
cex.budget     = NULL,
col.budget     = NULL,
with.ml        = c("mix","lat"),
...)
```

Arguments

x	A object of lba class.
dim	The dimention to be plotted. The default is c(1,2) to K = 2 and c(1,2,3) to K = 3.
xlim	The x limits (x1, x2) of the plot.
ylim	The y limits of the plot.
zlim	The z limits of the plot.
xlab	A label for the x axis, defaults to a description of "x".
ylab	A label for the y axis, defaults to a description of "y".
zlab	A label for the z axix, defaults to a description of "z".
rgl.use	A logical value. If TRUE the 3d scatter will be done with the rgl environment, in another way the scatterplot3d will be used.
metrics	Logical. If TRUE (default), the radius is plotted.
radius	A arbitrary number to choose the groups. The default is 0.5. See details.
col.points	The color points to be used, possibly vectors. The default is NULL. See datails.
height.points	Points label height in relation to the y-coordinate.The default is NULL.
labels.points	A character vector or expression specifying the _text_ to be written. The default is NULL.
pch.points	A symbols to use. O default is NULL.
pos.points	A position specifier for the text. If specified this overrides any "adj" value given. Values of "1", "2", "3" and "4", respectively indicate positions below, to the left of, above and to the right of the specified coordinates.
args.legend	List of additional arguments to be passed to legend; names of the list are used as argument names. Only used if K=2. The default is NULL.
pch.budget	A symbols to use. O default is NULL.
pos.budget	A position specifier for the text. If specified this overrides any "adj" value given. Values of "1", "2", "3" and "4", respectively indicate positions below, to the left of, above and to the right of the specified coordinates.

height.budget	Budget label height in relation to the y-coordinate.The default is NULL.
labels.budget	A character vector or expression specifying the _text_ to be written. The default is NULL.
cex.budget	The size of text. The default is NULL.
col.budget	The color budget to be used, possibly vectors. The default is NULL.
with.ml	Vector of two character strings specifying the parameters of the plot. Set "mix" to plot the mixing parameters and "lat" to plot the latent components. The default is "mix".
...	Further graphical parameters.

Details

The plotcorr suggested by Jelihovschi et all (2011), has a graphical display which uses the correspondence analysis graphics of the mixing parameters and latent components matrices. In this case, a graphic display is possible for K >= 2.

The argument radius was featured in order to help the user as he or she needs do decide which are the points belonging to a certain latent budget. Only the points to the right or left of LB1 and LB2 but always towards the center of the graphic (the zero of x axis) were taken in account, since those in opposite direction automatically belong to the closest latent budget. this argument only works for K = 2. It's should be of size two.

The argument col.points takes in account the argument radius in order to color the groups which either belong or not to a certain budget, therefore, the size of the vector of this argument must be equal to the number of formed groups.

Author(s)

Enio G. Jelihovschi (<eniojelihovs@gmail.com>)
Ivan Bezerra Allaman (<ivanalaman@gmail.com>)

References

de Leeuw, J., van der Heijden, P.G.M., and Verboon, P. 1990. "A latent time budget model". *Statistica Neerlandica*. 44, 1, 1-21.

Jelihovschi, E.G., Alves, R.R., and Correa, F.M. 2011. *Interacting latent budget analysis and correspondence analysis to analyze beauty salon management data*. Biometric Brazilian Journal, 29, 657-673.

van der Ark, A. L. 1999. *Contributions to Latent Budget Analysis, a tool for the analysis of comositional data*. Ph.D. Thesis University of Utrecht.

See Also

plot.default, scatterplot3d, plot3d.

Examples

```
data('votB')
K = 2
ex1 <- lba(parties ~ city,
           data=votB,
           K = 2)
plotcorr(ex1)

#It's very simple. with colors!
plotcorr(ex1,
         col.points = 3:5,
         col.budget = c(5,3))

#Changing radius!
plotcorr(ex1,
         radius = rep(0.7,2))

#Without metrics!
plotcorr(ex1,
         metrics = FALSE)

#Change legend options!
plotcorr(ex1,
         args.legend = list(ncol=3))

#Change height points!
plotcorr(ex1,
         height.points = rep(-0.1,6))


## Not run:
#K = 3
K = 3
ex2 <- lba(parties ~ city,
           data=votB,
           K = 3)

plotcorr(ex2)

#Change budget options
plotcorr(ex2,
         pch.budget = 5,
         col.budget = 2,
         labels.budget = c('lba1','lba2','lba3'))

#Change points options
plotcorr(ex2,
         pch.points = 20,
         col.points = 4,
         labels.points = rownames(ex2$Aoi),
         args.legend = list(plot=FALSE))
```

```
#Coloring the groups
plotcorr(ex2,
         col.points = c(1,2,2,3,3,2),
         col.budget = c(3,1,2),
         args.legend = list(ncol=3))

#K = 4
K = 4
data(postmater)
new_post <- as.matrix(postmater[,-1])
row.names(new_post) <- postmater[,1]

ex3 <- lba(new_post,
           K = K)

plotcorr(ex3)



#A bit didatic!
plotcorr(ex3,
         args.legend = list(x = -2.5,
                            y = 5.5,
                            xpd=TRUE,
                            ncol=5))

#Dynamic? Yes, you can!
plotcorr(ex3,
     rgl.use = TRUE)

## End(Not run)
```

`plotlba` *Plotlba objects using the approach suggested by van der Ark (1999).*

Description

S3 methods for `lba` objects.

Usage

```
## S3 method for class 'lba.1d'
plotlba(x,
        height.line    = NULL,
        xlab           = NULL,
        ylab           = NULL,
        ylim           = NULL,
        args.legend    = NULL,
```

```
        labels.points  = NULL,
        col.points     = par('col'),
        col.lines      = par('col'),
        lty.lines      = par('lty'),
        lwd.lines      = par('lwd'),
        pch.budget     = par('pch'),
        col.budget     = par('fg'),
        lty.budget     = par('lty'),
        lwd.budget     = par('lwd'),
        colline.budget = NULL,
        with.ml        = c("mix","lat"),
        ...)

## S3 method for class 'lba.2d'
plotlba(x,
        axis.labels    = NULL,
        labels.points  = NULL,
        col.points     = par('fg'),
        pch.budget     = par('pch'),
        col.budget     = par('fg'),
        lty.budget     = par('lty'),
        lwd.budget     = par('lwd'),
        colline.budget = par('fg'),
        args.legend    = NULL,
        with.ml        = c("mix","lat"),
        ...)
```

Arguments

`x`	A object of `lba` class.
`height.line`	Is a vector with the lines height when `K = 2`.
`xlab`	A title for the x axis.
`ylab`	A title for the y axis.
`ylim`	The y limits of the plot.
`args.legend`	List of additional arguments to be passed to `legend`; names of the list are used as argument names. The default is `NULL`.
`axis.labels`	Labels for the three axes in the order left, right, bottom. Defaults to the column names.
`labels.points`	A character vector or expression specifying the text to be written. The default is `NULL`.
`col.points`	A `vector` of colour representing the points of the mixing parameters. The default is `par('fg')`.
`col.lines`	A `vector` of colour representing the lines of the mixing parameters. The default is `par('fg')`.
`lty.lines`	A `vector` of line types representing the mixing parameters. The default is `par('lty')`.

lwd.lines	A vector of line width representing the mixing parameters. The default is par('lwd').
pch.budget	A vector of plotting characters or symbols representing the budget proportion. The default is par('pch').
col.budget	A vector of colour representing the budget proportion. The default is par('fg').
lty.budget	A vector of line types representing the budget proportion. The default is par('lty').
lwd.budget	A vector of line width representing the budget proportion. The default is par('lwd').
colline.budget	The colors for line budget. The default is par('fg').
with.ml	What's parameters do you like to plot? The default is mixing parameters ('mix').
...	Other graphical parameters may also be passed as arguments to these functions.

Details

The plotlba function, was suggested at de Leeuw et all (1990) and at van der Ark (1999) thesis. Those types of plots have only graphical views for K = 2 and K = 3. When K = 2, either the latent budgets or the mixing parameters are displayed on a (one dimensional) line segment. When K = 3, either the latent budgets or the mixing parameters are displayed in a equilateral triangle using a barycentric coordinate system where the budgets are represented by the vertices and the plot is made with help of triax.plot and triax.points function of **plotrix** package.

Author(s)

Enio G. Jelihovschi (<eniojelihovs@gmail.com>)
Ivan Bezerra Allaman (<ivanalaman@gmail.com>)

References

de Leeuw, J., van der Heijden, P.G.M., and Verboon, P. 1990. "A latent time budget model". *Statistica Neerlandica*. 44, 1, 1-21.

van der Ark, A. L. 1999. *Contributions to Latent Budget Analysis, a tool for the analysis of comositional data*. Ph.D. Thesis University of Utrecht.

See Also

triax.plot, triax.points.

Examples

```
data('votB')

#K = 2
ex1 <- lba(parties ~ city,
           data=votB,
           K = 2)

plotlba(ex1)
```

```
#It's very simple. With colors!
plotlba(ex1,
        col.points = 1:6,
        col.lines  = 1:6)

#Add title in plot!
plotlba(ex1,
        main='Mixing parameters')

#Change budget proportion!
plotlba(ex1,
        pch.budget = 23,
        col.budget = 9,
        colline.budget = 8,
        lwd.budget = 2,
        lty.budget = 2)

#A little more!
plotlba(ex1,
        xlab = 'Lb2 -> Lb1',
        height.line = rep(0.5,6),
        lty.lines = 2,
        args.legend = list(ncol=3))


## Not run:
#K = 3
data(MANHATAN)

tbm <- xtabs(value ~ sococon+health,
             MANHATAN)

ex2 <- lba(tbm,
           K = 3)

plotlba(ex2)

#A little more!
plotlba(ex2,
        labels.points = rownames(tbm),
        col.points    = 2:7,
        args.legend   = list(plot=F))

plotlba(ex2,
        col.points     = 3:8,
        col.budget     = 2,
        pch.budget     = 20,
        lty.budget     = 2,
        lwd.budget     = 3,
        colline.budget = 3,
        axis.labels    = c('Lba1','Lba2','Lba3'))
```

```
## End(Not run)
```

---

postmater *Environmental problems and Cancer*

Description

The `postmater` data frame has 13 rows and 8 columns. The raw data refers to a political and social survey across Europe that is conducted twice a year.

Usage

```
postmater
```

Format

This data frame contains the following columns:

country A factor with levels: `F` France; `B` Belgium; `NL` Netherlands; `D` Germany; `I` Italy; `L` Luxembourg. `DK` Denmark. `IRL` Ireland. `GB` Great Britain. `NIRL` Northern Ireland. `GR` Greece. `E` Spain. `P` Portugal.

m.. The absolute frequencies of materialist factor in the respect country. The degree of ranking of this index is ++.

m. The absolute frequencies of materialist factor in the respect country. The degree of ranking of this index is +.

m The absolute frequencies of materialist factor in the respect country. The degree of ranking of this index is below of the "m.".

m_pm The absolute frequencies of materialist/post-materialist factor in the respect country. The degree of ranking of this index is below of the "m".

pm The absolute frequencies of post-materialist factor in the respect country. The degree of ranking of this index is below of the "m_pm".

pm. The absolute frequencies of post-materialist factor in the respect country. The degree of ranking of this index is below of the "pm".

pm.. The absolute frequencies of post-materialist factor in the respect country. The degree of ranking of this index is below of the "pm.".

Source

Reif, K., and Melich, A. (1990). Euro-Barometer 29: Environmental problems and Cancer, March-April 1988. Ann Arbor: Inter-university Consortium for Political and Social Research.

References

van der Ark, A. L. 1999. *Contributions to Latent Budget Analysis, a tool for the analysis of compositional data*. Ph.D. Thesis University of Utrecht.

pregnancy *Pregnancy-Related Mortality in California*

Description

The `pregnancy` matrix has 16 rows and 5 columns. The raw data refers to California pregnancy-related deaths from 2002-2005.

Usage

`pregnancy`

Format

This matrix contains the following columns:

Pre.E Preeclampsia/eclampsia

OH Obstetric hemorrhage

CVD Cardiovascular diseases

DVTPE Deep vein thrombosis - pulmonary embolism

AFE Amniotic fluid embolism

The rows refers to:

Hfob Hispanic,foreign-born

Husb Hispanic, us-born

Wnh White, non-hispanic

Bnh Black, non-hispanic

<30b Maternal age

$30-40$b Maternal age

>40b Maternal age

1 Parity

$2-4$ Parity

$5+$ Parity

<30a Maternal age

$30-40$a Maternal age

>40a Maternal age

<32w Gestational age at delivery

$32-36$w Gestational age at delivery

>37w Gestational age at delivery

Source

Main, E. K.; et al. Pregnancy-Related Mortality in California: Causes, Characteristics, and Improvement Opportunities. *OBSTETRICS \& GYNECOLOGY*. **125**, 938–947.

References

Main, E. K.; et al. Pregnancy-Related Mortality in California: Causes, Characteristics, and Improvement Opportunities. *OBSTETRICS \& GYNECOLOGY*. **125**, 938–947.

`print.goodnessfit` *Print Method for goodnessfit objects.*

Description

Returns (and prints) a summary list for goodnessfit objects.

Usage

```
## S3 method for class 'goodnessfit.lba.ls'
print(x, digits=3L, ...)

## S3 method for class 'goodnessfit.lba.ls.fe'
print(x, digits=3L, ...)

## S3 method for class 'goodnessfit.lba.ls.logit'
print(x, digits=3L, ...)

## S3 method for class 'goodnessfit.lba.mle'
print(x, digits=3L, ...)

## S3 method for class 'goodnessfit.lba.mle.fe'
print(x, digits=3L, ...)

## S3 method for class 'goodnessfit.lba.mle.logit'
print(x, digits=3L, ...)
```

Arguments

`x`	A given object of the class `goodnessfit.lba.ls`, `goodnessfit.lba.ls.fe`, `goodnessfit.lba.ls.logit`, `goodnessfit.lba.mle.fe`, `goodnessfit.lba.mle.logit` and `goodnessfit.lba.mle`.
`digits`	A non-null value for digits specifies the minimum number of significant digits to be printed in values. The default is 3.
`...`	Further arguments (require by generic).

Author(s)

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Ivan Bezerra Allaman (<ivanalaman@gmail.com>)

See Also

`summary.goodnessfit.lba.ls`, `summary.goodnessfit.lba.mle`

Examples

```
data('votB')

# Using LS method (default) without constraint
# K = 2
ex1 <- lba(city ~ parties,
           votB,
           K = 2)
exm <- goodnessfit(ex1)
exm
```

`print.lba` *Print Method for* `lba` *objects.*

Description

Returns (and prints) a summary list for objects of class `lba.ls`, `lba.ls.fe`, `lba.ls.logit`, `lba.mle`, `lba.mle.fe`, and `lba.mle.logit`.

Usage

```
## S3 method for class 'lba.ls'
print(x, digits = 3L, ...)

## S3 method for class 'lba.ls.fe'
print(x, digits = 3L, ...)

## S3 method for class 'lba.ls.logit'
print(x, digits = 3L, ...)

## S3 method for class 'lba.mle'
print(x, digits = 3L, ...)

## S3 method for class 'lba.mle.fe'
print(x, digits = 3L, ...)

## S3 method for class 'lba.mle.logit'
print(x, digits = 3L, ...)
```

Arguments

`x`	A given object of the class `lba`, `lba.ls.fe`, `lba.mle.fe`, `lba.ls.logit` and `lba.mle.logit`.
`digits`	Number of decimal digits in the results. The default is 3.
`...`	Further arguments (require by generic).

Author(s)

Enio G. Jelihovschi (<eniojelihovs@gmail.com>)
Ivan Bezerra Allaman (<ivanalaman@gmail.com>)

See Also

`lba`

Examples

```
data('votB')

# Using LS method (default) without constraint
# K = 2
ex1 <- lba(city ~ parties,
           votB,
           K = 2)
ex1
```

`summary.goodnessfit` *Summary Method for goodnessfit objects.*

Description

Returns (and prints) a summary list for goodnessfit objects.

Usage

```
## S3 method for class 'goodnessfit.lba.ls'
summary(object, digits = 2L, ...)

## S3 method for class 'goodnessfit.lba.ls.fe'
summary(object, digits = 2L, ...)


## S3 method for class 'goodnessfit.lba.ls.logit'
summary(object, digits = 2L, ...)
```

```
## S3 method for class 'goodnessfit.lba.mle'
summary(object, digits = 2L, ...)


## S3 method for class 'goodnessfit.lba.mle.fe'
summary(object, digits = 2L, ...)


## S3 method for class 'goodnessfit.lba.mle.logit'
summary(object, digits = 2L, ...)
```

Arguments

object	A given object of the class goodnessfit.lba.ls and goodnessfit.lba.mle.
digits	Number of decimal digits in the results. The default is 2.
...	Further arguments (require by generic).

Author(s)

Enio G. Jelihovschi (<eniojelihovs@gmail.com>)
Ivan Bezerra Allaman (<ivanalaman@gmail.com>)

See Also

goodnessfit

Examples

```
data('votB')

# Using LS method (default) without constraint
# K = 2
ex1 <- lba(city ~ parties,
           votB,
           K = 2)
exm <- goodnessfit(ex1)
summary(exm)
```

---

summary.lba *Summary Method for* lba *objects.*

Description

Returns (and prints) a summary list for objects of class lba, lba.ls.fe, lba.ls.logit, lba.mle, lba.mle.fe, and lba.mle.logit.

Usage

```
## S3 method for class 'lba.ls'
summary(object, digits = 2L, ...)

## S3 method for class 'lba.ls.fe'
summary(object, digits = 2L, ...)

## S3 method for class 'lba.ls.logit'
summary(object, digits = 2L, ...)

## S3 method for class 'lba.mle'
summary(object, digits = 2L, ...)

## S3 method for class 'lba.mle.fe'
summary(object, digits = 2L, ...)

## S3 method for class 'lba.mle.logit'
summary(object, digits = 2L, ...)
```

Arguments

`object`	A given object of the class `lba`, `lba.ls.fe`, `lba.mle.fe`, `lba.ls.logit` and `lba.mle.logit`.
`digits`	Number of decimal digits in the results.The default is 2.
`...`	Further arguments (require by generic).

Author(s)

Enio G. Jelihovschi (<eniojelihovs@gmail.com>)
Ivan Bezerra Allaman (<ivanalaman@gmail.com>)

See Also

`lba`

Examples

```
data('votB')

# Using LS method (default) without constraint
# K = 2
ex1 <- lba(city ~ parties,
           votB,
           K = 2)
summary(ex1)
```

votB *Voting Behaviour in Netherlands*

Description

The votB data frame has 8971 rows and 2 columns. The raw data refers to the type of the city and the political party which each participant voted for in the 1986 general elections in the Netherlands.

Usage

```
votB
```

Format

This data frame contains the following columns:

city A factor with levels: co Commuter; lx Large city; mc Middle large city; ri Rural industrialised; ru Rural; sc Small city.

parties A factor with levels: cda Christian democrats; d66 Democrats; left Other left-wing parties; Pvda Labor party; right Other right-wing parties; vvd Liberals.

Source

Statistics Netherlands (1987). Statistiek der verkiezingen 1986. Tweede Kamer der Staten-Generaal 21 mei 1996. [Statistics of the elections of the Lower House, May 21-th 1996]. The Hague: Staatsuitgeverij.

References

van der Ark, A. L. 1999. *Contributions to Latent Budget Analysis, a tool for the analysis of compositional data*. Ph.D. Thesis University of Utrecht.

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